DISCOVERER RESEARCH

SUBSATELLITE

Declassified and Released by the N R O

In Accordance with E. O. 12958

NOV 26 1997

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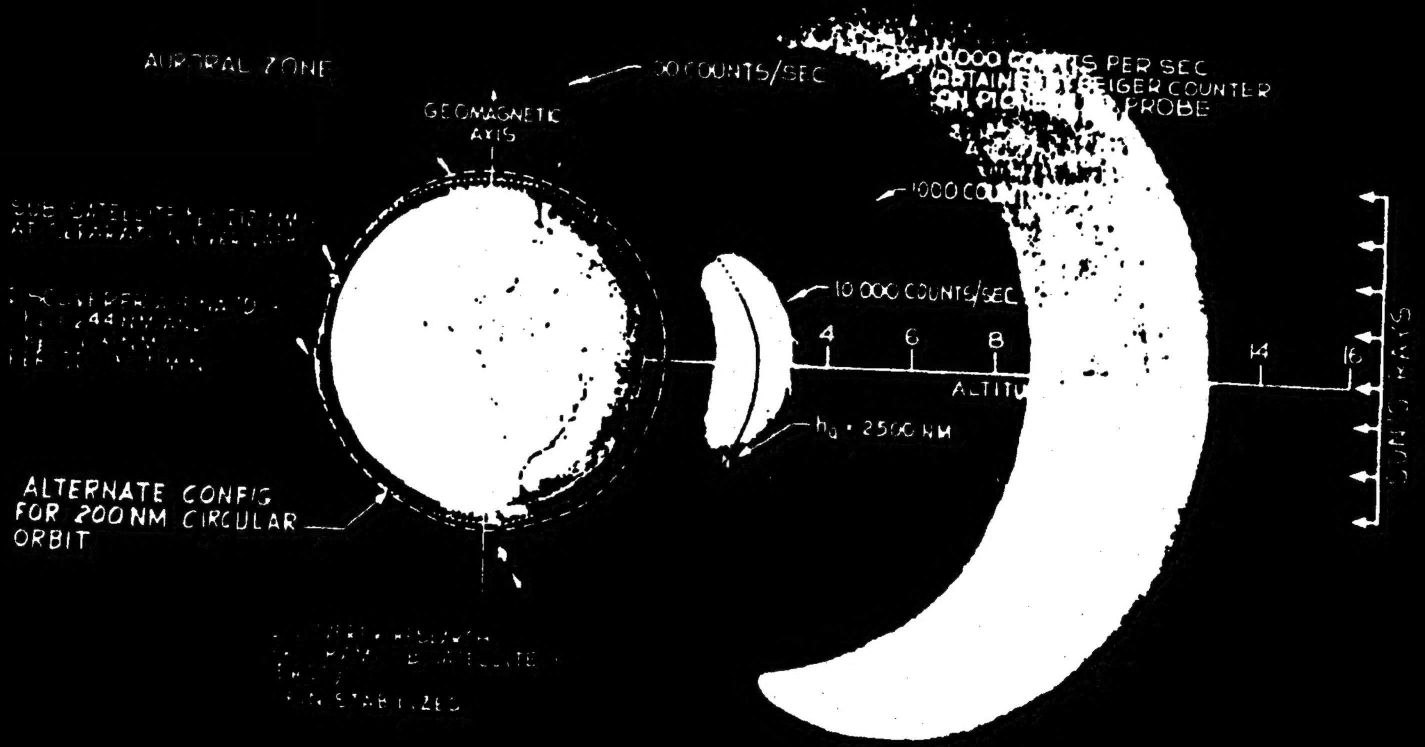
DISCOVERER RESEARCH PROGRAM

SUBSATELLITE FLT CHARACTERISTICS



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SUBSATELLITE

- TO PROVIDE A VEHICLE
  1. CAPABLE OF INCREASED ORBIT RANGES
  2. WITH EXTENDED ACTIVE LIFE (2 TO 6 MONTHS)
  3. TO CARRY A WIDE VARIETY OF RESEARCH EXPERIMENTS

- SUBSATELLITE CONFIGURED TO FIT ON AGENA D AFT RACK.
- THE SUBSATELLITE PROPULSION UNIT MAY BE VARIED TO ACHIEVE DIFFERENT ORBITS.
- BASIC STRUCTURE AND ELECTRONIC EQUIPMENT SUITABLE TO ACCOMMODATE RESEARCH EXPERIMENTS.
- ELECTRIC POWER MAY BE BATTERIES AND/OR SOLAR CELLS.

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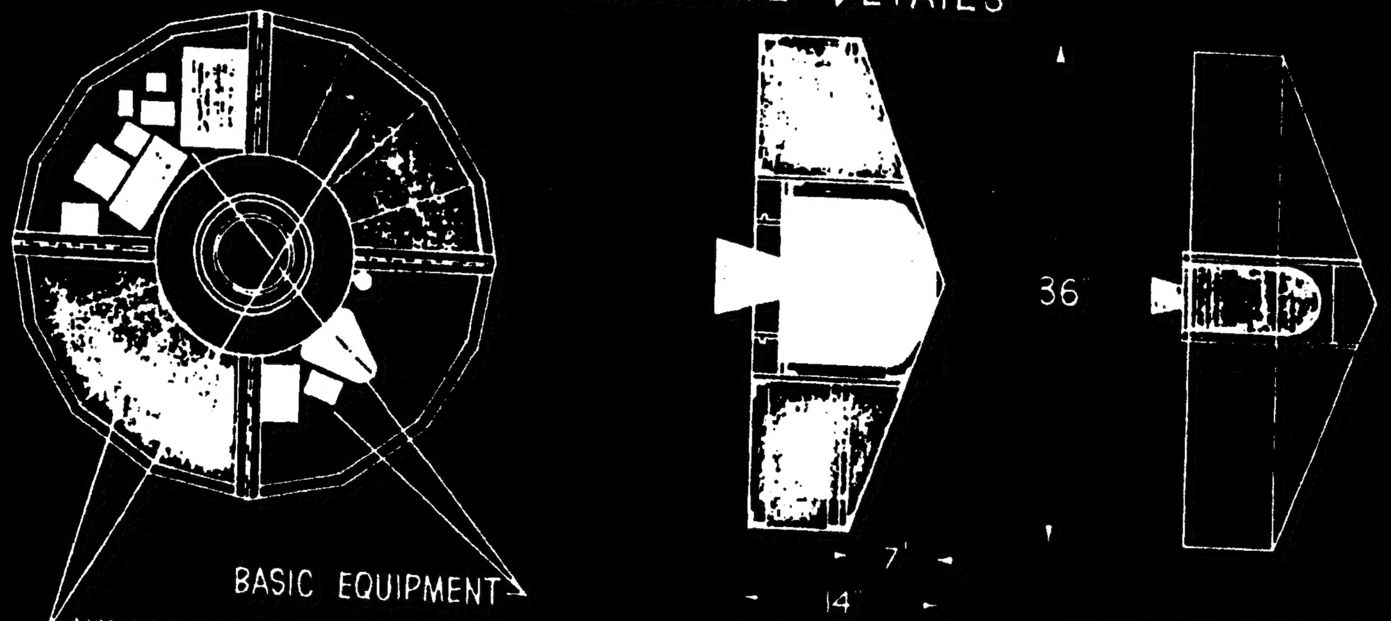
SUBSATELLITE DETAILS



- ● TE 316 ROCKET
- ○ 2000 NM APOGEE (FOR 225 LBS)
- ○ PAYLOAD SENSOR VOLUME = 3000 CU IN

ALTERNATE CONFIGURATION

- ● TE 344 ROCKET
- ○ 200 NM CIRCULARIZED ORBIT
- ○ PAYLOAD SENSOR VOLUME = 3750 CU. IN.

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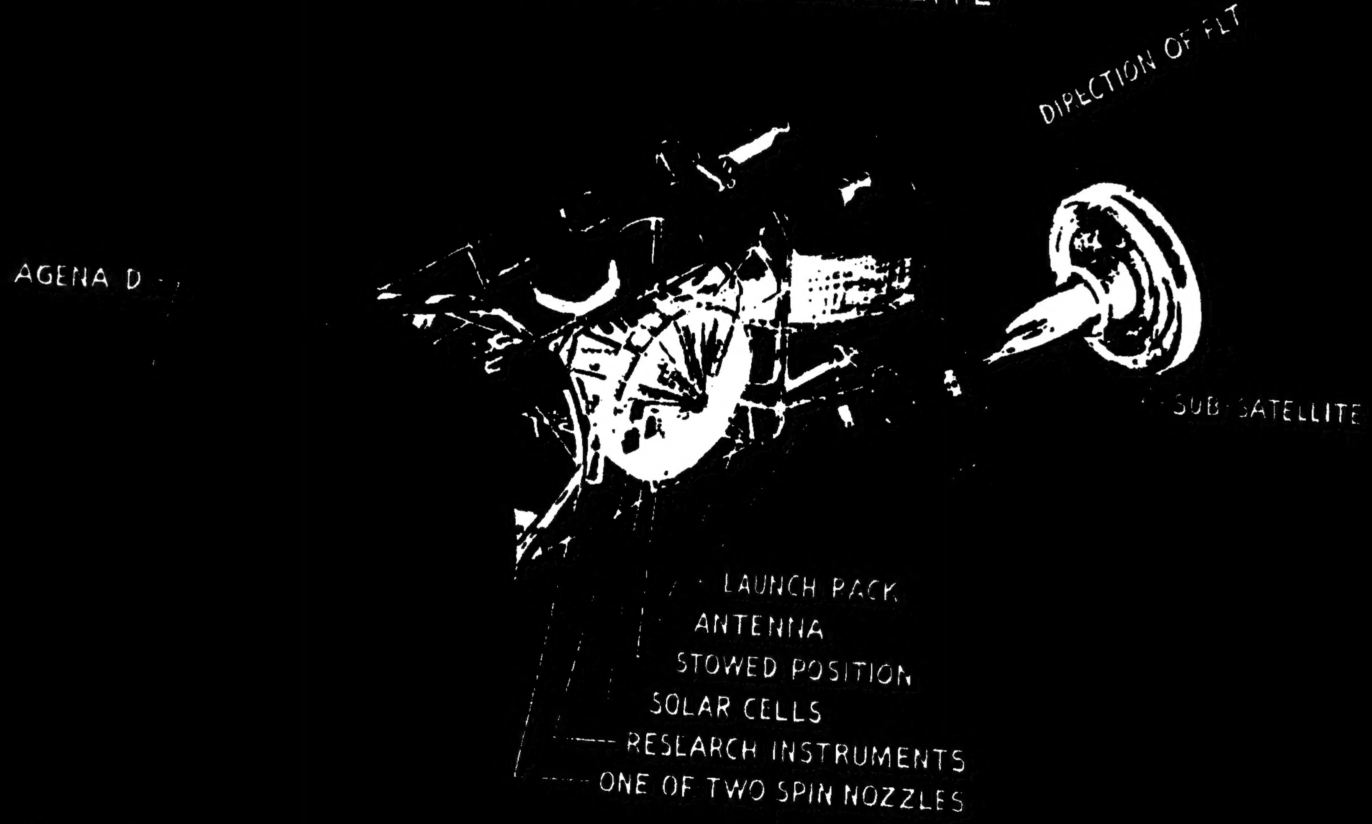
LAUNCHING OF SUB-SATELLITE



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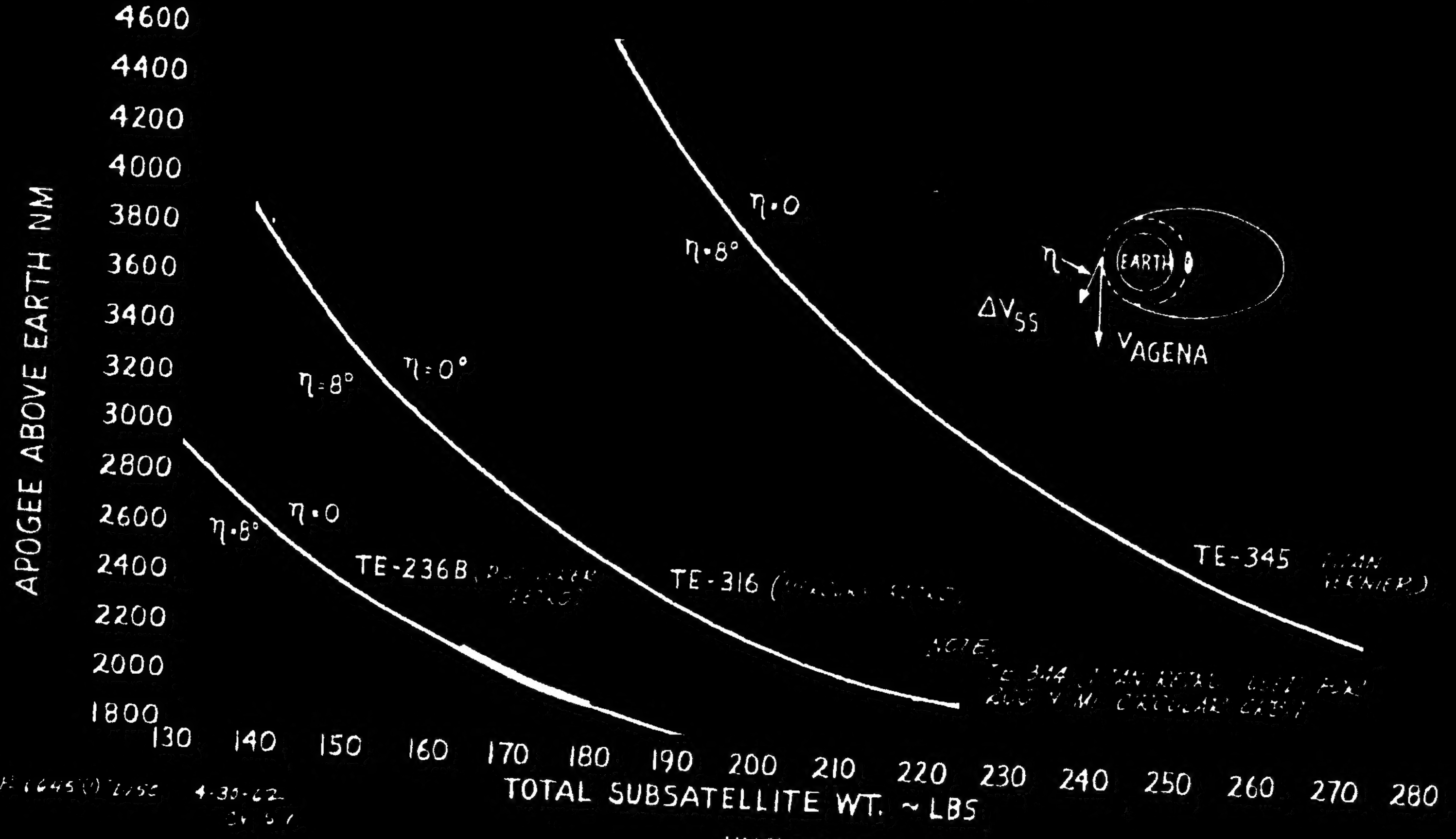
SUBSATELLITE WT. VS APOGEE



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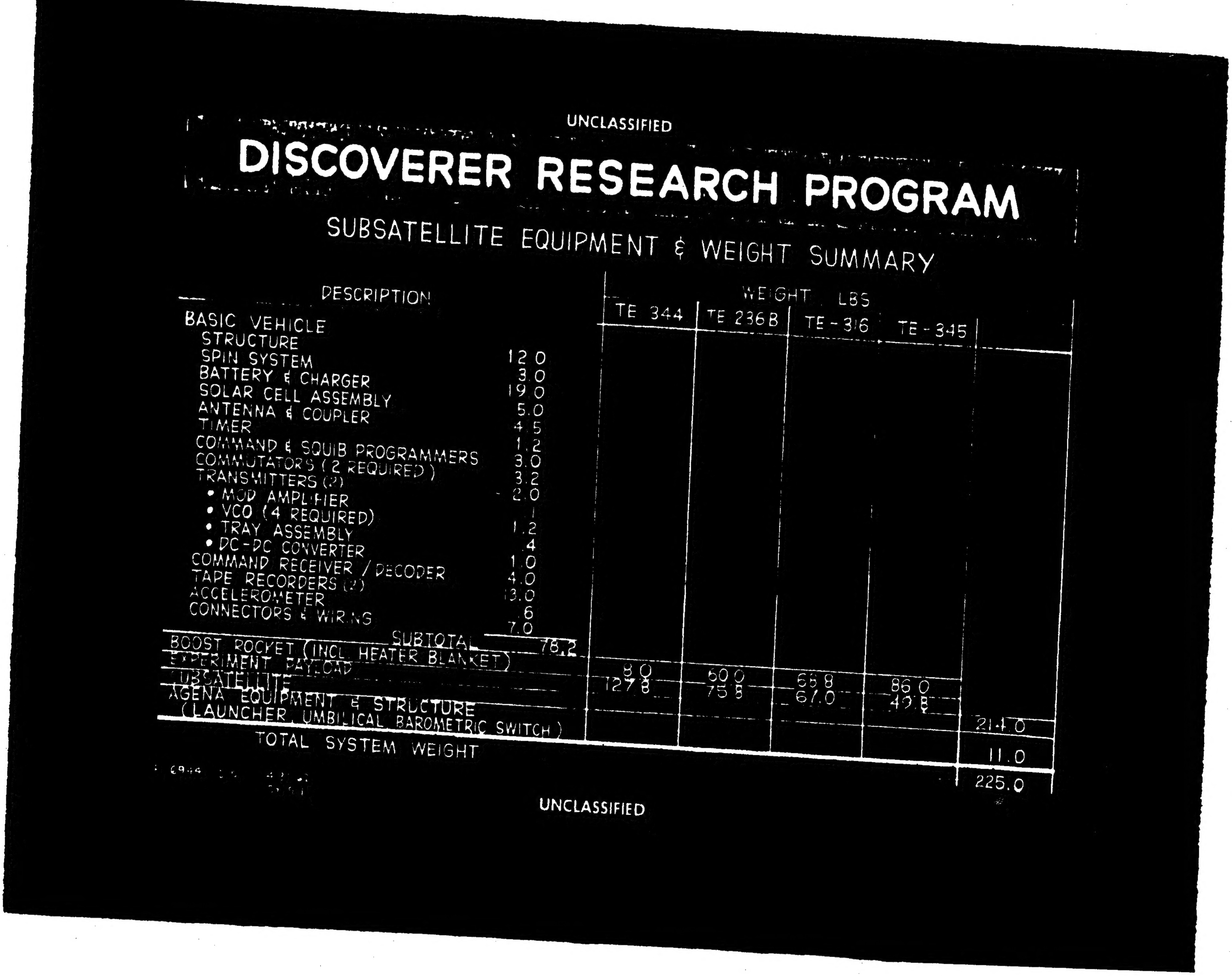

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SUBSATELLITE EQUIPMENT & WEIGHT SUMMARY

DESCRIPTION		WEIGHT LBS TE 344	TE 236B	TE-316	TE-345	
BASIC VEHICLE						
STRUCTURE	12.0					
SPIN SYSTEM	3.0					
BATTERY & CHARGER	19.0					
SOLAR CELL ASSEMBLY	5.0					
ANTENNA & COUPLER	4.5					
TIMER	1.2					
COMMAND & SQUIB PROGRAMMERS	3.0					
COMMUTATORS (2 REQUIRED)	3.2					
TRANSMITTERS (2)	2.0					
• MOD AMPLIFIER	.1					
• VCO (4 REQUIRED)	1.2					
• TRAY ASSEMBLY	.4					
• DC-DC CONVERTER	1.0					
COMMAND RECEIVER / DECODER	4.0					
TAPE RECORDERS (2)	13.0					
ACCELEROMETER	.6					
CONNECTORS & WIRING	7.0					
SUBTOTAL	78.2					
BOOST ROCKET (INCL. HEATER BLANKET)		8.0	60.0	68.8	86.0	
EXPERIMENT PAYLOAD		127.8	75.8	67.0	49.8	
SUBSATELLITE						214.0
AGENA EQUIPMENT & STRUCTURE (LAUNCHER, UMBILICAL, BAROMETRIC SWITCH)						11.0
TOTAL SYSTEM WEIGHT						225.0

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2500 N.M. ~ SUBSATELLITE POWER SUMMARY

DESCRIPTION	POWER (WATT)	DUTY CYCLE* (PERCENT)	W-HR* ORBIT
COMMAND RECEIVER	0.35	100	0.81
TAPE RECORDER	4.0	100	9.20
T/M TRANSMITTER			
DC-DC CONVERTER	18.0	10	4.14
MOD AMPLIFIER			
VCO (4 UNITS) @ 30 MA	3.36	10	.77
COMMUTATOR (2 UNITS) @ 1.6 W	3.6	100	8.26
TIME REFERENCE GENERATOR	0.5	100	1.15
COMMAND & SQUIB PROGRAMMER	1.5	10	0.35
RESEARCH INST	13.0	100	29.90
TIMER	1.5	10	.35
TOTAL	≈ 46		≈ 55

* OPERATIONAL DUTY CYCLE BASED ON 2.3 HRS PER ORBIT, AVERAGE POWER OF 15 WATTS FOR SOLAR CELLS, AND A 1.75 AMP-HR NI-CAD BATTERY IS AS FOLLOWS:

2.3 HRS/ORBIT - ON
FOUR ORBITS - OFF

* ORBIT - 137 MIN = 2.3 HRS

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SUB-SATELLITE COMMAND LINK CALCULATION

	GAINS	LOSSES
TRANSMISSION SYSTEM		
R.F. POWER 1000 WATTS	+30 db	
ANTENNA GAIN	+10 db	
RANGE 5000 N.M. (SLANT RANGE)		-154 db
RECEIVING SYSTEM		
RECEIVER SENSITIVITY	+132 db	
ANTENNA GAIN		-3 db
FADE LOSS		-3 db
POLARIZATION LOSS		-3 db
TOTALS	+172 db	-163 db

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SUB SATELLITE TELEMETRY LINK CALCULATION

	GAINS	LOSSES
TRANSMISSION SYSTEM:		
R.F. POWER 2 WATTS	+3 db	
ANTENNA GAIN		−3 db
RANGE 5000 NM (SLANT RANGE)		−157 db
RECEIVING SYSTEM:		
RECEIVER SENSITIVITY	+139 db	
ANTENNA GAIN TLM-18	+28 db	
FADE LOSS		−3 db
POLARIZATION LOSS		−3 db
TOTALS	+170 db	−166 db
	+4	

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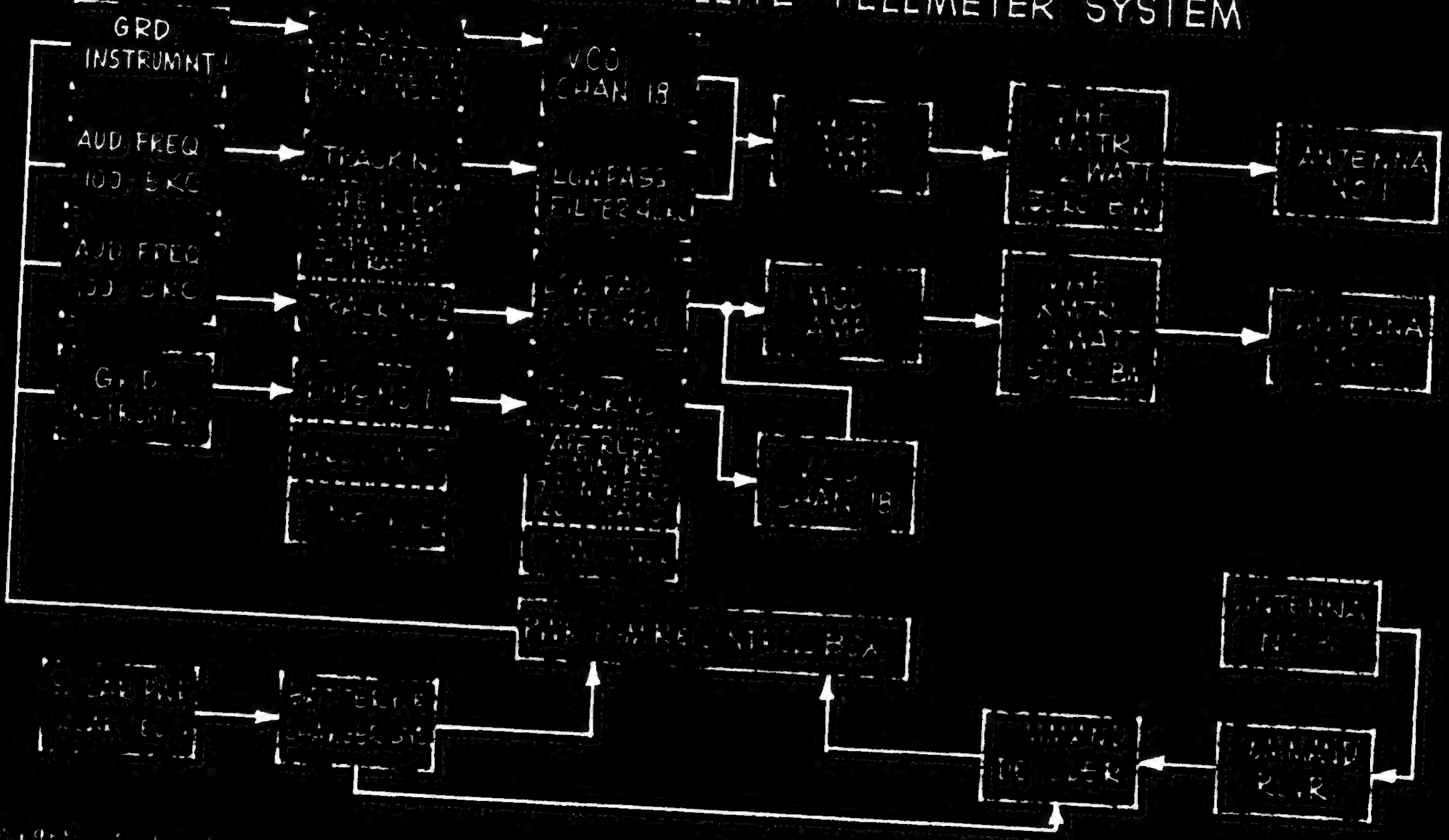
200 N. MI ~ SUBSATELLITE TELEMETER SYSTEM



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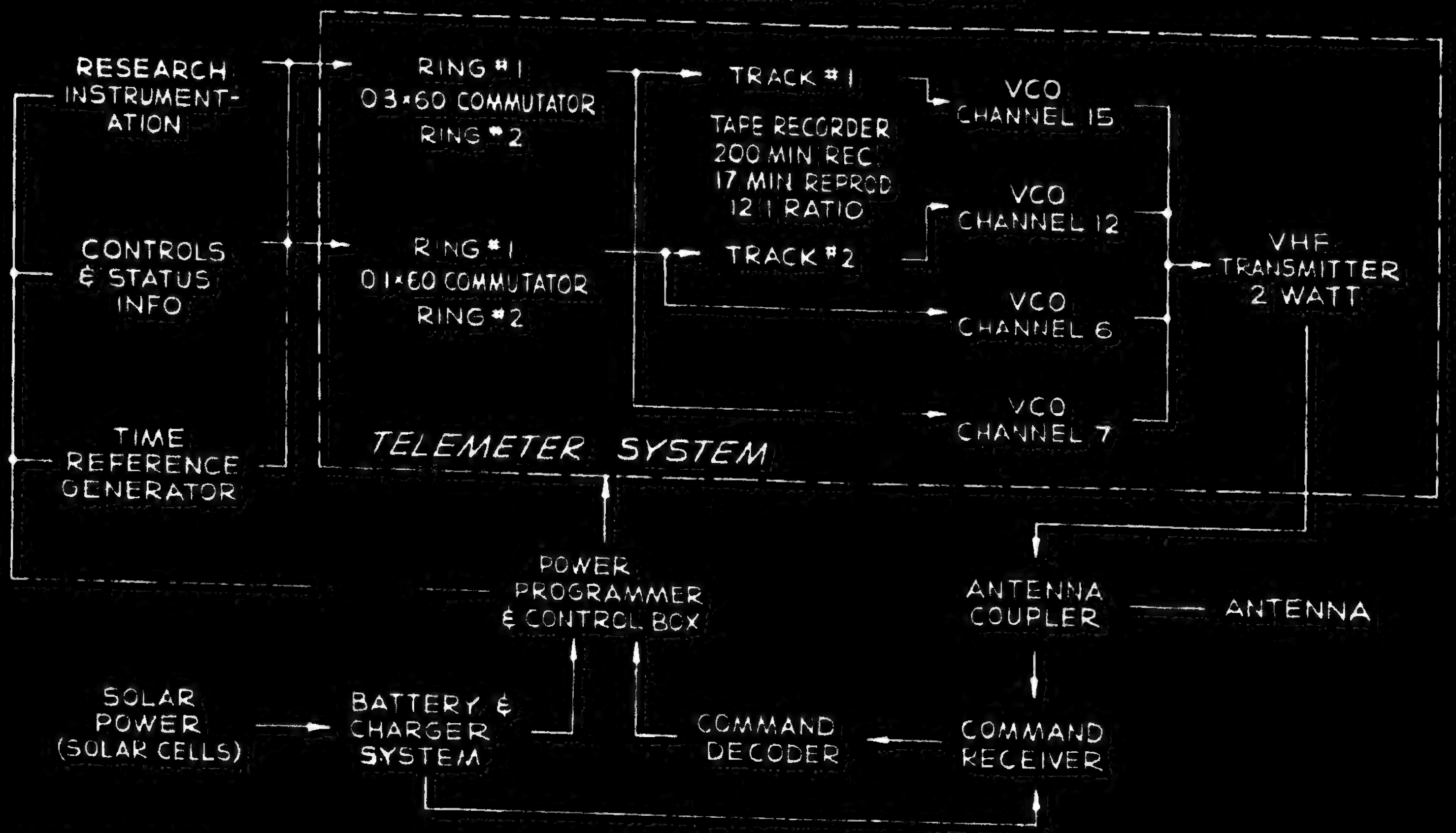
2500 N M SUBSATELLITE SYSTEM



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SUBSATELLITE TRACKING

- "SPADATS" FOR PRIMARY EPHEMERIS DATA
  - DELETES NEED FOR TRACKING BEACON
  - MUCH MORE ACCURATE & RELIABLE THAN ANGLES ONLY
- SATELLITE TEST CENTER GENERATES ACQUISITION MESSAGES
  - ACQUISITION MESSAGES TO HAWAII & VANDENBERG, NTS TRACKING STATIONS
- HAWAII & VANDENBERG FOR COMMAND & TELEMETRY DATA READOUT
  - NO ADDITIONAL MAJOR C & C EQUIPMENTS REQUIRED
  - NO ADDITIONAL COMMAND OR READOUT STATIONS REQUIRED

NEW BOSTON TRACKING STATION USED IN SUPPORT OF ABOVE FOR 200 N. MI. CIRCULAR ORBIT

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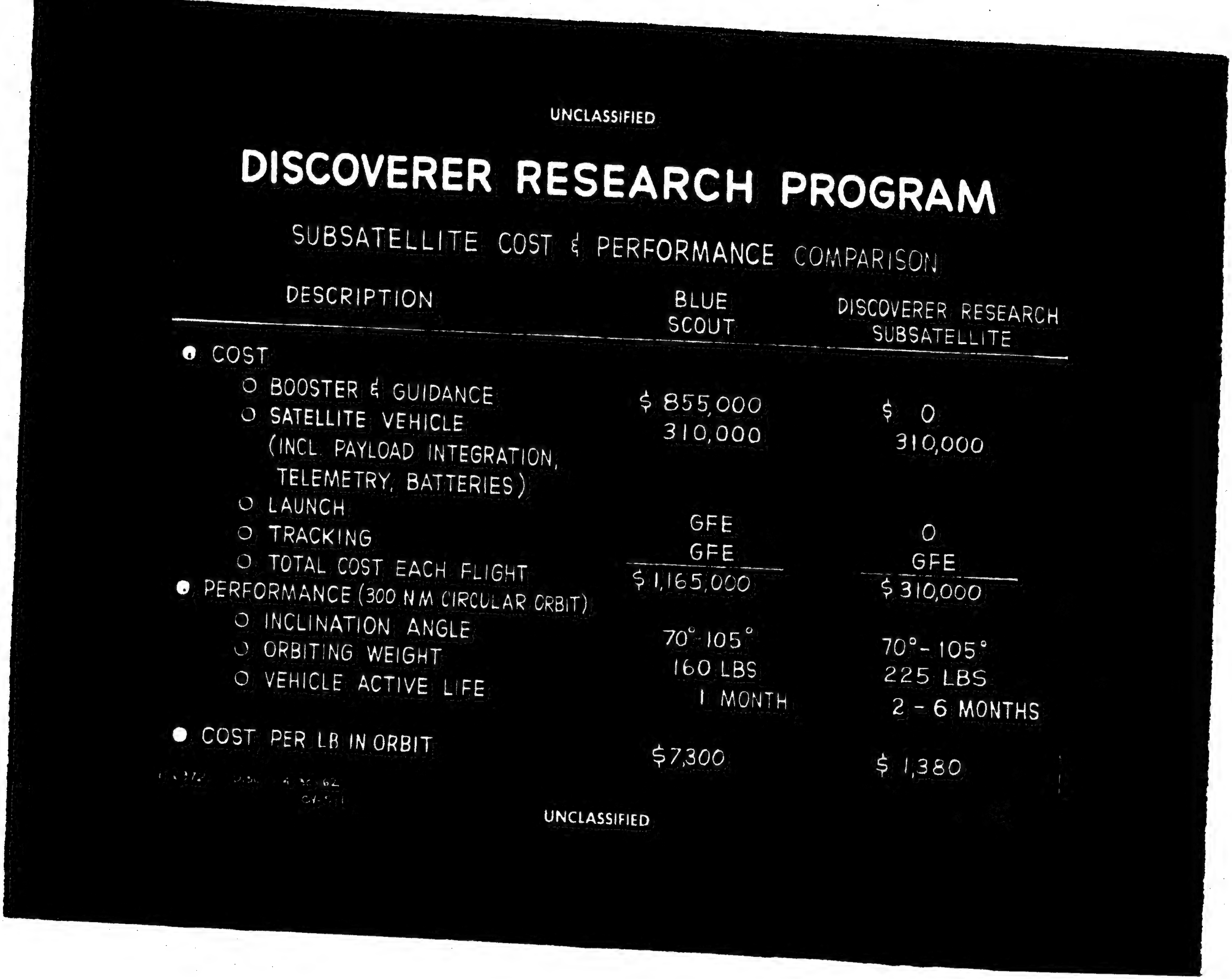

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SUBSATELLITE COST & PERFORMANCE COMPARISON

DESCRIPTION	BLUE SCOUT	DISCOVERER RESEARCH SUBSATELLITE
● COST		
○ BOOSTER & GUIDANCE	$ 855,000	$ 0
○ SATELLITE VEHICLE (INCL. PAYLOAD INTEGRATION, TELEMETRY, BATTERIES)	310,000	310,000
○ LAUNCH	GFE	0
○ TRACKING	GFE	GFE
○ TOTAL COST EACH FLIGHT	$ 1,165,000	$ 310,000
● PERFORMANCE (300 N.M. CIRCULAR ORBIT)		
○ INCLINATION ANGLE	70°-105°	70°-105°
○ ORBITING WEIGHT	160 LBS	225 LBS
○ VEHICLE ACTIVE LIFE	1 MONTH	2 - 6 MONTHS
● COST PER LB IN ORBIT	$7,300	$ 1,380

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SUBSATELLITE SYSTEM RELIABILITY

ROCKET MOTOR & SPIN SYSTEM	0.990
LAUNCHER MECHANISM	0.999
COMMAND SYSTEM	0.971
TELEMETRY SYSTEM	0.940
POWER SYSTEM	0.942
OVERALL SYSTEM	0.850

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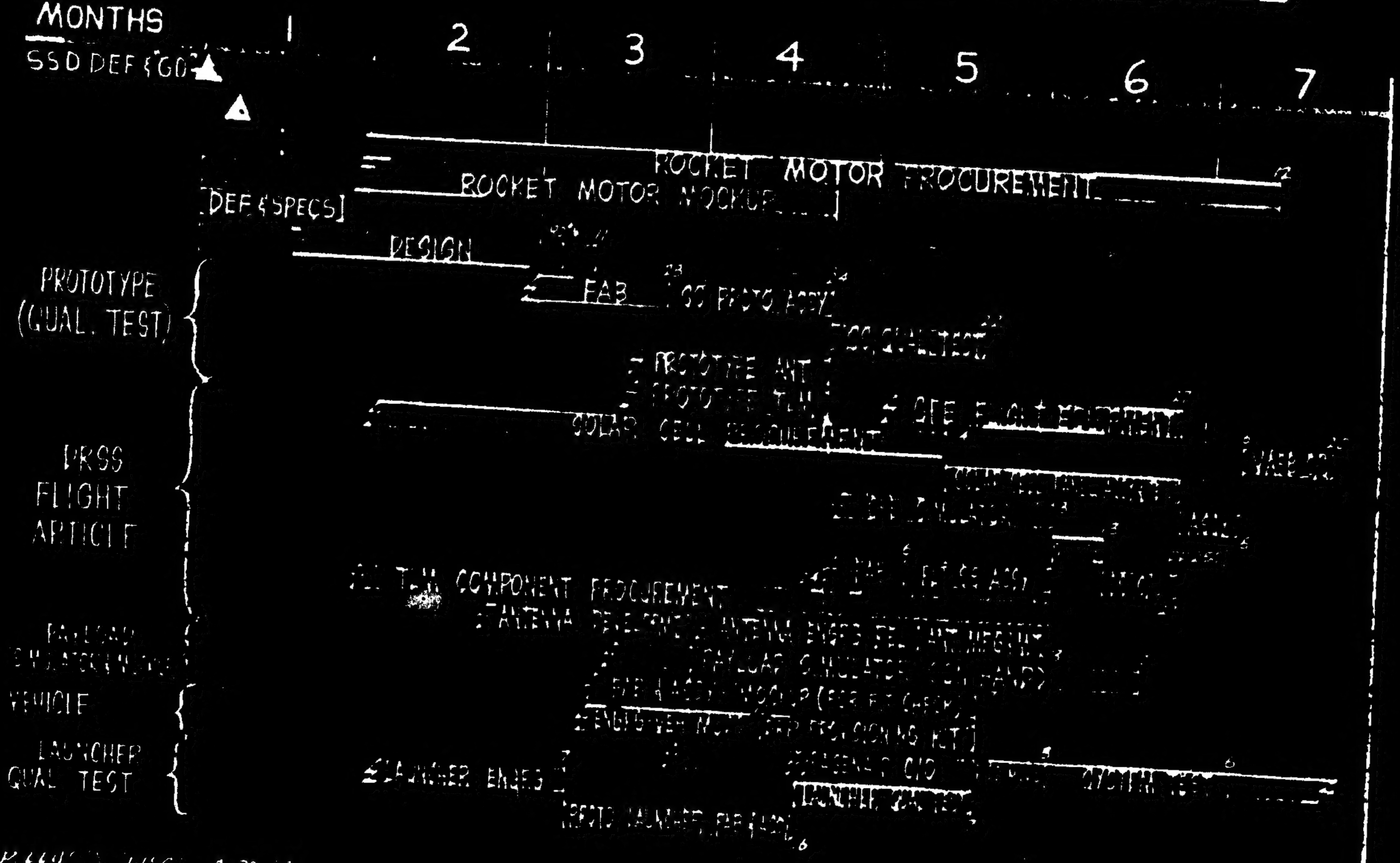
DRP SUBSATELLITE PROGRAM SCHEDULE



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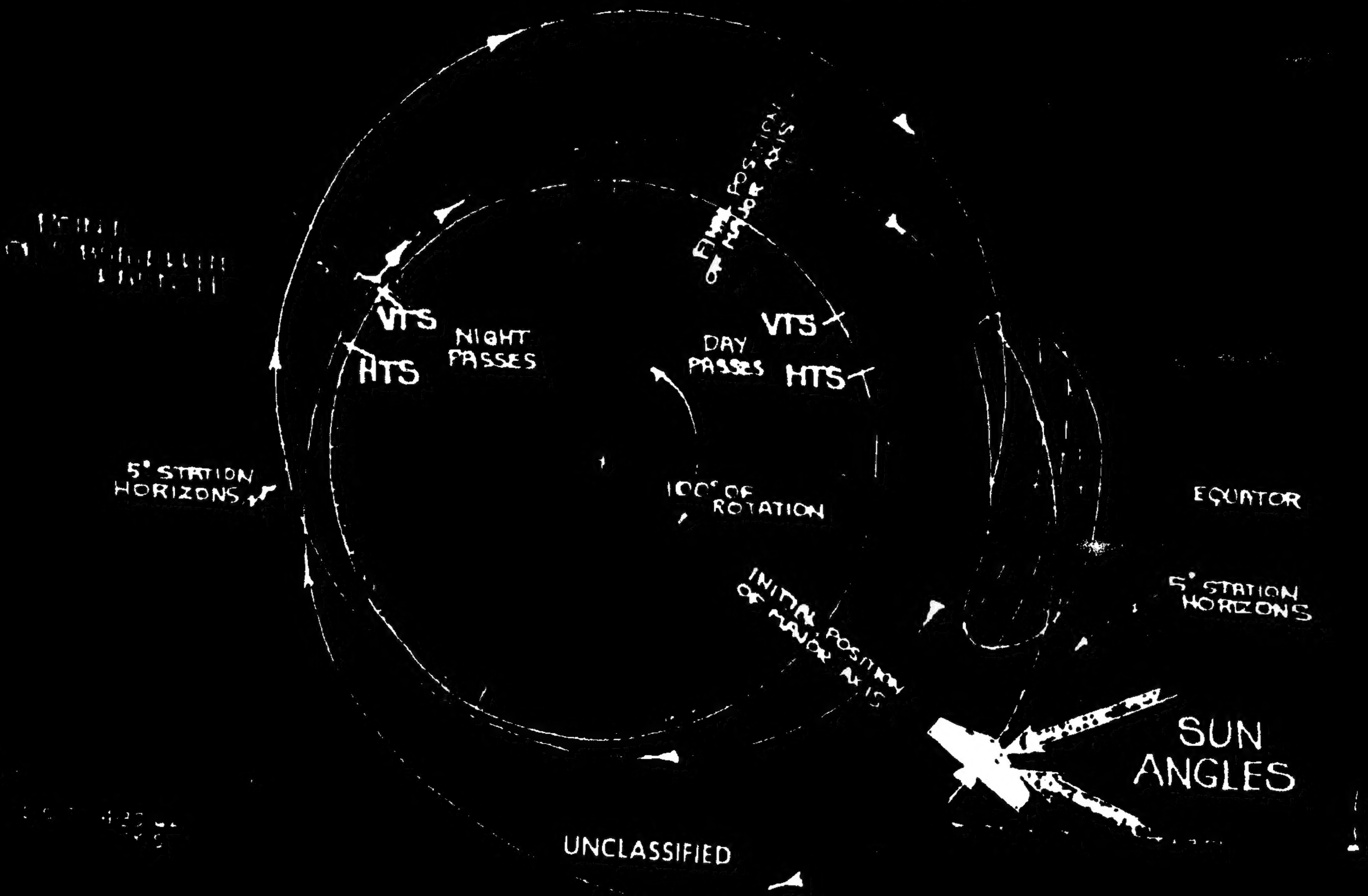
SUBSATELLITE APOGEE ROTATION



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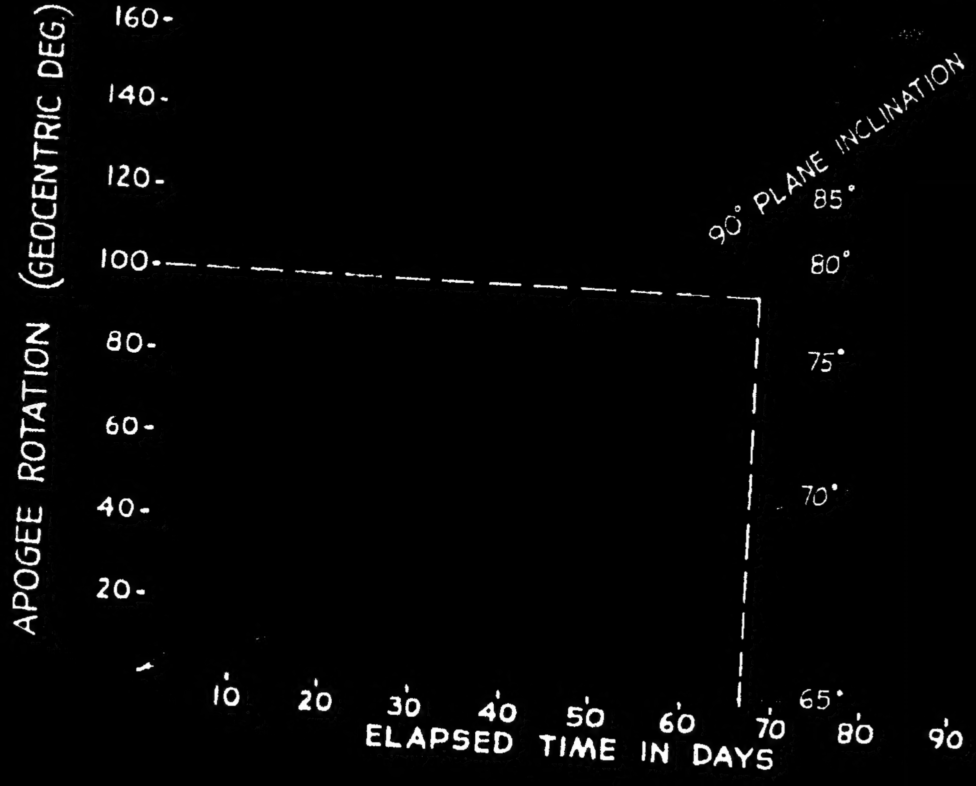
SUBSATELLITE APOGEE ROTATION VS ELAPSED TIME



NOTE :
APOGEE = 2500 N.M.

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DISCOVERER RESEARCH SUBSATELLITE

SYSTEM RELIABILITY

DESCRIPTION	(4) DUTY CYCLE (PERCENT)	(1) LIFE (PERCENT PROBABILITY OF SURVIVAL	(2) MEANTIME TO FAILURE (θ - HOUR)	COMPONENT RELIABILITY (R)
COMMAND SYSTEM				
RECEIVER	100	99.9 % FOR 100 HOURS	10^5	0.985 (3)
DECODER	100	99.9 % FOR 100 HOURS	10^5	0.985 (3)
			COMMAND SYSTEM RELIABILITY	0.971
TELEMETRY SYSTEM				
TRANSMITTER	10	MINIMUM OF 10000 HOURS	2.0×10^4	0.999
DC-DC CONVERTER	10	(95 % FOR 10,000 HOURS)	1.92×10^5	0.999
VCO	10	95 % FOR 2,000 HOURS	3.84×10^4	0.999
COMMUTATOR (SWITCH TYPE)	100	95 % FOR 1,000 HOURS	1.92×10^4	0.990
TAPE RECORDER	100	95 % FOR 200 HOURS	3.84×10^3	0.954
TIME REF GEN	100	98 % FOR 2,000 HOURS	9.9×10^4	0.998
			TELEMETRY SYSTEM RELIABILITY	0.940
POWER SYSTEM				
SOLAR CELLS	100	95 % FOR 1440 HOURS (ESTIMATED)	2.81×10^4	0.950
BATTERY	100	95 % FOR 15000 HOURS	2.25×10^5	0.994
POWER PROGRAMMER & CONTROL	100	95 % FOR 20000 HOURS	3.84×10^5	0.999
			POWER SYSTEM RELIABILITY	0.942

OVERALL SYSTEM RELIABILITY = 0.860

NOTE:
1. PER INDIVIDUAL SPECIFICATIONS
2. ASSUME EXPONENTIAL DENSITY FUNCTION $R = e^{-t/\theta}$
3. LIFE TEST ON SIMILAR EQUIPMENT CONDUCTED AT GEORGE C. MARSHALL SPACE FLIGHT CENTER - TOTAL NUMBER OF INTERROGATION CYCLES COMPLETED CORRESPONDS TO MAXIMUM INTERROGATION FOR 25 YEARS
4. ASSUMED - ACTIVE LIFE OF SUBSATELLITE OF 60 DAYS (3 HOURS OF OPERATION PER DAY)

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